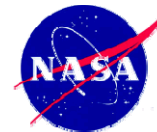




Intercomparisons of Aura MLS, ACE, and HALOE Tracers using the LaRC Lagrangian Chemistry and Transport Model

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Introduction:

- We use the LaRC Lagrangian Chemistry and Transport Model (LCTM) [Considine et al., 2007; Pierce et al., 2003] to intercompare ACE, Aura, and HALOE observations of long-lived trace species.

- The LCTM calculates the transport, mixing, and photochemical evolution of an ensemble of parcels that have been initialized from ACE-FTS measurements.

- Here we focus on late November, 2004 comparisons, due to the previous 3-week period of continuous HALOE observations and MLS v2.2 data on November 29, 2004.

- DAS-driven transport and relatively short trajectory lifetimes promotes strong influence of initializing observations on subsequent LCTM constituent distributions.

- Large number of model parcels produces more coincident measurements for intercomparisons and allows comparison of meridional and longitudinal variations.

LaRC LCTM Model Description:

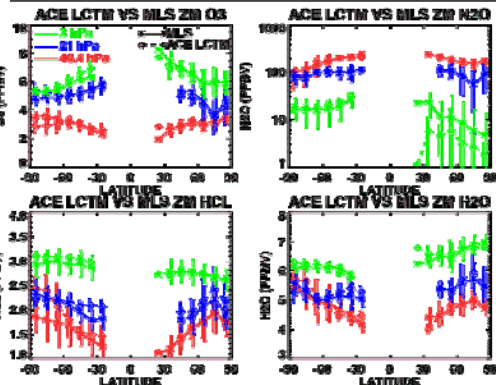
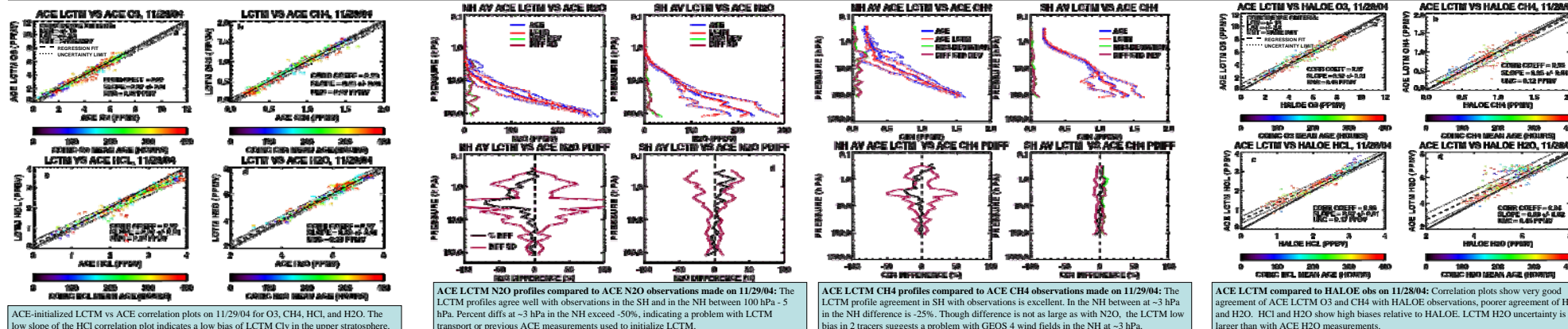
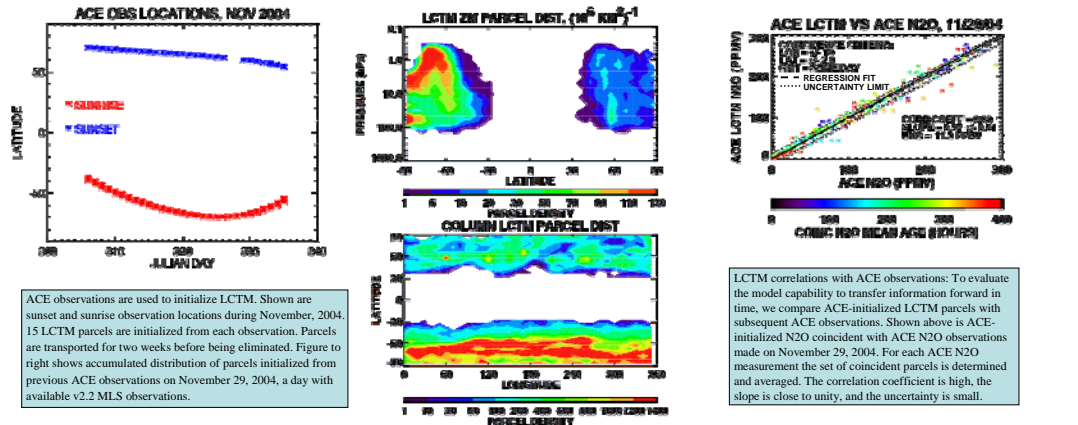
- Model tracks transport, mixing, and photochemical evolution of parcels initialized from observations.
- NASA GEOS-4 DAS meteorological data:
 - 1.25° lon x 1° lat x 55 eta levels, .01 hPa top.
- 6-hour average horizontal winds and vertical pressure velocity from DAS to kinematically advect parcels.
- Parcels initialized from ACE observations.
- Other species in standard stratospheric chemical mechanism initialized using parcel O₃, CH₄, and model climatology mapped to 0 and CH₄.
- Overhead column O₃ calculated from GEOS-4 DAS PV and Aura MLS O₃ mapping for each run day.
- Kawa lookup table photolysis parameterization.
- Interparcel mixing parameterization [Fairlie et al., 1999] included.
- Type 1 and Type 2 PSC Parameterization included.

References:

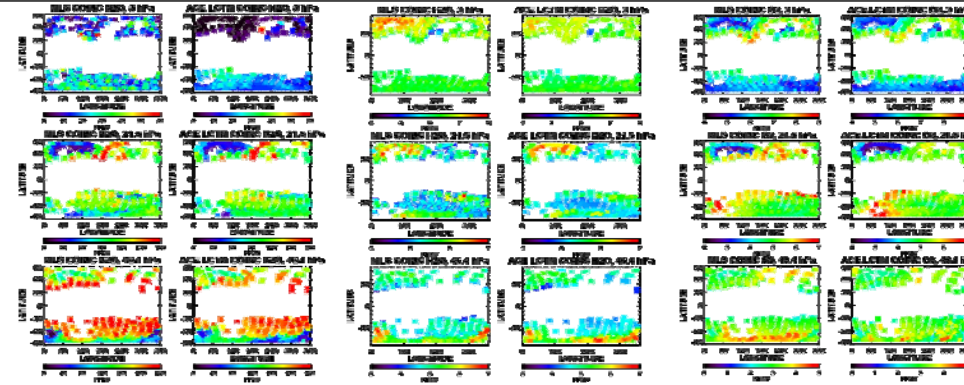
- Considine, D. B., et al., J. Geophys. Res., submitted, 2007.
- Fairlie, T. D., et al., J. Geophys. Res., 104, 26,597-26,609, 1999.
- Pierce, R.B., et al., J. Geophys. Res., 108 (D5), 8317, doi:10.1029/2001JD001063, 2003.

Run Description:

- Run dates: 11/1/2004 - 11/30/2004.
- Parcel lifetime: 2 weeks.
- Parcels initialized per occultation event: 15.
- ~90000 parcels in LCTM ensemble by end of simulation.
- Parcels only initialized when all observed species have signal/noise ratio > 0.3.
- Parcel diagnostics output every 6 hours.
- LCTM output compared to v2 ACE, v2.2 Aura MLS observations and v19 HALOE observations.



ACE LCTM compared to MLS observations of O₃, N₂O, HCl, and H₂O: Shown are zonal mean plots at 3, 21.5, and 46.4 hPa. Error bars are standard deviations, not standard error. ACE LCTM meridional distributions compare well with MLS. Note the 3 hPa deficit of N₂O in the NH and high SH HCl high bias at 46.4 hPa.



Horizontal distributions of MLS and ACE LCTM N₂O at 3, 21.5, and 46.4 hPa. LCTM represents MLS horizontal variations well. Note high latitude 3 hPa LCTM low bias due to excessive downwelling in GEOS 4 DAS met data.

Horizontal distributions of MLS and ACE LCTM H₂O at 3, 21.5, and 46.4 hPa. LCTM low bias in NH polar vortex region is consistent with excessive downwelling given vertical gradients of H₂O in that region.

Horizontal distributions of MLS and ACE LCTM O₃ at 3, 21.5, and 46.4 hPa. Very good correspondence of LCTM with MLS observations at all levels.

Conclusions

- LCTM initialized with ACE-FTS observations reproduces subsequent ACE-FTS tracer observations, demonstrating capability of model to follow the evolution of ACE-observed air parcels:
 - 50% deficits in LCTM-predicted NH upper stratospheric N₂O and ~25% deficits in CH₄ suggest GEOS4-DAS met fields have excessive vertical descent in the NH upper stratosphere during November, 2004.
 - Upper stratosphere low biases in LCTM HCl indicate low Cly initialization.
 - Otherwise relatively low uncertainties and high correlations.
- Comparisons of ACE-initialized LCTM with HALOE observations show ACE/HALOE biases consistent with published results (HALOE HCl and H₂O are low-biased relative to ACE observations).
- Comparisons with MLS of ACE-initialized LCM H₂O, N₂O, O₃, and HCl exhibit good reproduction of both longitudinal variability and zonal mean meridional variability.
- LCTM N₂O in NH upper stratosphere is strongly affected by excessive downwelling in developing NH polar vortex.